



Pathways of adaptation to external stressors in coastal natural-resource-dependent communities: Implications for climate change

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ABSTRACT

Adaptation to climate change is one of the greatest challenges facing coastal communities today. Coastal communities are subject to a wide range of stressors related to climate change, including biological resource decline and natural hazards. Small historically natural-resource-dependent communities are particularly vulnerable because of their close reliance on ecosystem goods and services that are likely to be affected by climate change (e.g., fisheries, forests) and their limited access to outside technical and financial resources needed for adaptation. Exogenous adaptation policies, while helpful for fostering new behavioral adjustments to address resource decline and natural hazards, can in some cases exacerbate socioeconomic disruption, further burdening communities already struggling to adapt. This paper presents an investigation of how six historically natural-resource-dependent coastal communities in Oregon, USA, have experienced and responded to external stressors and how adaptation in these communities has been shaped by interactions between past and present practices, processes, and vulnerabilities. Despite climate-related impacts identified by the scientific community, climate change was not salient in the community members' reports of stressors and impacts, and thus was not a trigger of adaptation. Rather, communities were responding to stressors associated with decades of declines in natural resource industries, an economic recession, restrictive natural resource management and land use policies, demographic change, and natural hazards. These findings confirm other research findings that chronic everyday problems, including those related to the maintenance of livelihoods, or consequences of inadequate livelihoods, often eclipse potentially disastrous threats in the minds of rural community members, thereby influencing adaptation strategies. In some cases communities do not prioritize such threats because people have come to accept living with them, or they feel powerless and unable to change the circumstances of daily life. The findings improve understanding of adaptation in natural-resource-based coastal communities in the USA and support the need for policy makers and planners to integrate climate change adaptation into livelihood improvement strategies.

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1. Introduction

Adaptation to climate change is one of the greatest challenges facing coastal communities (Adger et al., 2007). Coastal communities are subject to a wide range of stressors related to climate change, including change in ocean temperature, loss of habitat, and natural hazards such as storms and sea level rise (Dolan & Walker, 2006; McGranahan, Balk, & Anderson, 2007; Moser, Williams, & Boesch, 2012). Nonurban coastal communities are particularly vulnerable because of their relatively high exposure and sensitivity: these communities are often in direct proximity to climate-related hazards—in many cases the entire community lies within a hazard zone—and they often lack well-developed critical

and essential care services and diversified economies that enable them to tap alternative streams of revenue if one stream is adversely impacted (Cross, 2001; Lal, Alavalapati, & Mercer, 2011; Porfiriev, 2009). Moreover, because these communities are often isolated and economically stressed, they may have limited access to technical and financial resources needed for adaptation (Cross, 2001; Trainor et al., 2009).

Historically natural-resource-dependent communities, i.e., those in which a large proportion of employment or employment income is generated through resource activities such as forestry, fisheries, mining, and energy (Humphrey, 1993), may be especially sensitive because of their reliance on industries and ecosystem goods and services that may be affected by climate change (Coles & Scott, 2009; Davidson, Williamson, & Parkins, 2003; Donohue & Sturtevant, 2007; Flint & Luloff, 2005; Karl, Melillo, & Peterson,

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2009; Lal et al., 2011; Magis, 2010; Trainor et al., 2009; Lynn & Donoghue, 2011). In addition, the compromised health and lack of mobility of very young and elderly people, who comprise the majority of the population in many rural communities, increases risk of thermal stress, diseases, allergies, and other adverse effects of extreme weather (Krawchenko, Keefe, Manuel, & Rapaport, 2016; Lal et al., 2011). Communities in areas with disproportionately large amounts of public lands and waters, as in much of the rural western United States, may be especially sensitive to changing ecological conditions because of their lack of opportunity for pursuing alternative economic activities on lands around them (Geisler, 1995; Peluso, Humphrey, & Fortmann, 1994; Walker, 2003; West, 1994). Low per-capita income, high unemployment, persistent poverty, and dependence on public services and government transfers have rendered such rural populations lacking in resources to draw on for adaptation (Cross, 2001; Lal et al., 2011).

A substantial body of empirical research has investigated exposure and sensitivity to climate change among coastal communities in the US and other developed countries (Clark et al., 1998; Cross, 2001; Emrich & Cutter, 2011; Wood, Burton, & Cutter, 2010; Wu, Yarnal, & Fisher, 2002), as well as factors that explain risk mitigation and adaptation to climate change-related natural hazards at the level of individuals (Elrick-Barr, Thomsen, Preston, & Smith, 2017; Koerth, Vafeidis, Hinkel, & Sterr, 2013). However, capacity for adaptation to climate change at the community-level is less well documented, potentially due to the challenges of studying this phenomenon. Climate change impacts people through multiple interacting stressors that reveal themselves at different spatial and temporal scales, making it difficult to attribute behavioral adjustments to changes in climate and evaluate how behavioral adjustments contribute to welfare over the long term. Moreover, climate change is a contested concept in the conservative rural US, which challenges data collection.

This paper uses a pathways framework (Haasnoot, Kwakkel, Walker, & ter Maat, 2013; Wilson, 2014; Wise et al., 2014) to explain how six natural-resource-dependent coastal communities in Oregon, USA responded to change within a broader context of interactions between socio-economic and environmental external stressors and vulnerabilities. The research question was: what factors explain how rural historically natural-resource-dependent coastal communities adapt to change? Theories of adaptation to natural hazards, climate-related changes, and other stressors are drawn upon to interpret the findings about community responses to past stressors for future climate change. The findings increase understanding of processes of adaptation in rural natural-resource-based coastal communities in the USA and other developed countries and present considerations for investigations of future climate change adaptation. After a review of the literature, including theories of adaptation and the pathways framework, the methods are presented, followed by a discussion of the results, and a discussion of implications for climate change adaptation.

2. Literature review

“Adaptation” in social systems refers to the process of change in human behavior, in response to change in the physical or social environment, to better allow the system to cope, manage, or adjust (Denevan, 1983; Nelson, Adger, & Brown, 2007; Smit, Burton, Klein, & Street, 1999). Increased fitness, or suitability to the environment, is often considered an indicator of adaptation in the strict sense (Sober, 1993). Adaptation can be distinguished from maladaptation, which refers to an effort to adapt that has the unintended result of increasing vulnerability of other groups and sectors (Barnett & O'Neill, 2010). Adaptation—generally considered a long-term shift in behavior—is also sometimes distinguished from

coping, which involves temporary adjustment in response to change or to mitigate shocks and stresses (Blaikie, Cannon, Davis, & Wisner, 1994; Opiyo, Wasonga, Nyangito, Schilling, & Munang, 2015), and manipulation, which refers to short-term change in an external system to make self-regulation unnecessary (Thomsen, Smith, & Keys, 2012).

Adaptation is differentiated on the basis of (a) who is engaging in the behavioral adjustment, (b) to what is the actor adjusting, and (c) how is the actor adjusting (Smit, Burton, Klein, & Wandel, 2000). The actor can be an individual or group (Smit et al., 2000). The actor can adjust to long-term changes, mid-term shifts, or sudden events (Smit et al., 2000). Adaptation can be reactive or anticipatory, spontaneous or planned (Fankhauser, Smith, & Tol, 1999; Smit et al., 2000; Smithers & Smit, 1997). Adaptation can span a range of behaviors from recognition to intention to action. Adaptation can involve raising awareness of climate-related changes; developing plans to mitigate risks by adjusting human behaviors, institutions, technologies, policies, programs, and built environments; and implementing these plans (Berrang-Ford, Ford, & Paterson, 2011; Biagini, Bierbaum, Stults, Dobardzic, & McNeeley, 2014; Lesnikowski et al., 2013). Reactive adaptation may focus on avoiding, retreating, coping, accommodating, adjusting, spreading risk, and securing resources, whereas proactive adaptation may focus on planning, monitoring, increasing awareness, building partnerships, and enhancing learning or research (Berrang-Ford et al., 2011; Fazey et al., 2010).

Although adaptation to climate change occurs at the scale of individuals and groups, it is shaped by a broader context of vulnerability, specifically conditions of exposure, sensitivity, and adaptive capacity. Exposure refers to the potential magnitude, frequency, duration, and extent of climate-related changes or disturbances by virtue of a community's geographic location (Adger, 2006). Sensitivity refers to the degree to which communities may be affected or harmed by climate-related changes because of their economic or cultural reliance on or interdependence with ecosystem goods and services that could be altered by climate change, and general susceptibility to stress and access to resources (Andrey & Jones, 2008; Cutter, 1996; Cutter, Boruff, & Shirley, 2003; Finan, West, Austin, & McGuire, 2002; Lynn & Donoghue, 2011; Smit & Wandel, 2006; Tierney, Lindell, & Perry, 2001; Vásquez-León et al., 2003; West and Vásquez-León, 2008).

Adaptive capacity refers to the ability to modify social norms, behaviors, and policies in order to anticipate or reduce risk, take advantage of opportunities, adjust to change, mitigate potential damages, or cope with consequences (McCarthy, Canziani, Leary, Dokken, & White, 2001). At the level of individuals adaptive capacity is predicated on knowledge, skills, and physical capacity; access to information and resources; perceptions and attitudes toward risks, capacities and opportunities (Elrick-Barr et al., 2017; Koerth et al., 2013). At the level of communities and social groups, broader structures and processes are also at work (Magis, 2010; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008). At this level, effective governance enables people and organizations to adjust to changes by modifying social norms, behaviors, and policies, and to implement adaptation decisions (Adger, 2003; Nelson et al., 2007). Culture is also important. Place attachment and continuity of place and livelihood practices is an important part of cultural identity; relocation and restricting relationships with a resource-base can cause financial and emotional stress and weaken social networks (Adger, Barnett, Brown, Marshall, & O'Brien, 2013; Brown & Westaway, 2011; Buikstra et al., 2010). Exogenous policy interventions can also be important. For example, financial and technical assistance can build capacity for adaptation, rules and regulations can enforce baseline planning and risk mitigation, and incentives can encourage innovation and investment. However, exogenous policy interventions can also, in some cases,

exacerbate current socioeconomic problems (Thomsen et al., 2012), as when well-intentioned efforts to address changes inadvertently impose costs and constrain economic opportunity in local communities. Moreover, lack of deliberate coordination of adaptation and livelihood improvement strategies can allow existing vulnerabilities to persist and deny communities opportunity to take advantage of adaptation options.

The notion of pathways provides a nuanced way to consider adaptation in the context past conditions that have shaped vulnerability, specifically as a thread within a wider process of societal transition through interacting cultural, political, economic, and environmental change (Haasnoot et al., 2013; Wilson, 2014; Wise et al., 2014) and in response to cumulative pressures resulting from these interacting changes (Smith, Thomsen, Gould, Schmitt, & Schlegel, 2013). From this perspective, adaptation derives from a set of processes that occur through linear time, punctuated by key decision and intervention points that influence the direction of change (Fazey et al., 2016; Wilson, 2014) rather than simply abrupt events separate from social, political, and environmental processes (Haasnoot et al., 2013; Wise et al., 2014). Pathways are therefore rarely static and usually change course on the basis of various factors of change (Wilson, 2014). Such a perspective allows for acknowledgment of intertemporal and interspatial forces that render communities differentially capable of adapting (Wise et al., 2014). Investigating adaptation through a pathways lens fosters consideration of how available resources and coevolving knowledge, values, rules, and norms define the social context of an adaptation issue, expand or limit the scope of adaptation behaviors, and enable or constrain how different pathways might emerge (Fazey et al., 2016). This pathways framing takes into account positive feedback loops and system inertia that enable and constrain adaptation and that express themselves as path dependency, social memory, and rigid states, or lock-ins (Wilson, 2014; Wise et al., 2014).

“Path dependency” refers to the condition in which steps or nodes of change in a pathway are determined by the previous ones (Pierson, 2000; Wilson, 2014). Similar to the idea of hysteresis effect, in which humans maintain their tendencies even when no longer adapted to the environment (Hardy, 2014), path dependency describes how available resources and coevolving knowledge, values, rules, and norms define the social context of adaptation, expand or limit the scope of adaptation behaviors, and enable or constrain how different pathways might emerge (Wilson, 2014). Created by ideological commitments and political, institutional, and social legacies that filter learning and decision-making options (Bailey & Wilson, 2009), path dependency is further influenced by human institutions and forms of governance (frequently at the national and supranational level) that influence transitional processes, often in the shape of relatively narrowly defined pathways of change (Wilson, 2012, 2014), although deliberate political pressure can change pathways (Garrelts & Lange, 2011). Social memory—that is, the knowledge, experience, and accumulated wisdom passed on from generation to generation and from actor to actor within a community—is a crucial factor in path dependency and in adjustment of future pathways (Wilson, 2014). Pathways can become locked in as a result of structural conditions beyond the control of a community (e.g., political power inequalities, geographic isolation, centralizing energy, transport and food networks that leave communities on the periphery); economic conditions that create poverty and deny communities access to resources; and sociopsychological orientations that result in conservatism and resistance to change (Wilson, 2014). Path dependencies and lock-ins and the social memory that influences them thus create opportunities and challenges for communities’ responses

to socioeconomic and environmental stress, predisposing them to various types of decisions.

3. Methods

The research followed an inductive comparative case approach (Yin, 2009) to describe and explain response to external stressors in a set of small historically natural-resource dependent coastal communities in Oregon. Comparative case studies provide an opportunity to generalize findings to other similar cases, e.g., other small historically natural-resource-dependent coastal communities in developed countries such as the USA (Yin, 2009). Qualitative interviews were used to (1) identify the primary external stressors that Oregon’s coastal communities experienced, (2) characterize how communities responded to external stressors, and (3) explain why they responded in the ways that they did. The communities were compared and contrasted on their experiences and responses to identify pathways through which communities transitioned and the key conditions that may have shaped these transitions.

3.1. The Oregon Coast

Situated between the Pacific Ocean and the Oregon Coast Range, the Oregon Coast is the narrow strip of coastal land that runs north-south along the western border of the state of Oregon, USA. About 60 miles to the east, across the Coast Range, lies the Willamette Valley, a fertile agricultural area that is home to Oregon’s largest cities and political centers: Portland, Eugene, and the state capital of Salem. Regular rainfall and snowmelt from the coastal mountains produce ecologically diverse and productive temperate rainforests in this seismically active region, and cold Pacific currents and numerous bays and reefs create rich marine habitats for many species of rockfish, tuna, salmon, and migrating whales. The entire coast is located in the Cascadia subduction zone, the geographic area that will be inundated with seawater from a tsunami in the event of an earthquake along the fault that runs from Vancouver Island, British Columbia, to northern California. The Oregon Coast is rural, and a majority of communities are small (less than 10,000 residents) and were historically dependent on natural resource-based activities. Fishing and forestry were the mainstay of Oregon’s coastal communities until the 1990s, when concerns about sustainability prompted harvest restrictions, and wider economic trends led to industry consolidation and shifts in production and processing to other regions of the United States and abroad (Freudenburg, Wilson, & O’Leary, 1998). The decline of timber and fishing shattered the bedrock of many of Oregon’s coastal communities. The more recent establishment of a series of environmental rules and regulations, including those that limit harvest to protect fish and wildfire species, has compounded socioeconomic stress in these communities, while the influx of tourists and retirees drawn to the area’s scenic beauty and mild climate has challenged the social cohesion. Moreover, Oregon’s coastal communities have begun to experience higher wave heights, more powerful winter storms, and increasing sea levels and ocean shoreline erosion in recent years (Dalton, Mote, & Snover, 2013). Ocean temperatures and acidification levels off the Northwest coast have also increased (Dalton et al., 2013). In the forests of the Oregon Coast Range, areas of mixed evergreen and deciduous forest are projected to expand, shifting composition away from Douglas fir, the most economically important species; in addition, mortality from wildfire and tree pests and pathogens is expected to rise (Dalton et al., 2013; Shafer et al., 2010). These climate-related changes, which are projected to get worse, threaten the built environment in Oregon’s coastal communities

and the abundance and distribution of natural resources on which the communities depend.

3.2. Community case selection

The six coastal communities of study (Table 1, Fig. 1) were selected on the basis of variation in variables related to their potential exposure, sensitivity and capacity to adapt to external stressors. Large and small communities (relative to the average size of coastal communities, which is small) were chosen because of the theorized relationship between population size and resources (Cross, 2001). More and less isolated communities were chosen because of the theorized relationship between geographic location in relation to urban centers and transportation routes and access to resources (Wilson, 2014). The communities were also selected to achieve balance in orientation around the major socioeconomic sectors in Oregon's coastal communities—fishing, timber, tourism, and retirement—all of which are likely to be negatively affected by climate change (Lal et al., 2011) but each of which may create different options for responding (Wilson, 2007). The six communities, from south to north, included:

1. Gold Beach is a small isolated community located on the southern coast of Oregon within forty miles of the California border that shifted to tourism and sport fishing after the collapse of fishing and logging industries.
2. Port Orford is a very small isolated fishing community with strong community engagement located along the southern coast with an open ocean harbor that leaves it more prone to storms than other ports along the Oregon coast and subjects it directly to fluctuations and long-term changes in sea level.
3. Florence is a rapidly growing tourist and retirement destination community, once oriented around logging, located on the mouth of the Siuslaw River where a major highway from the Willamette Valley meets the ocean.
4. Newport, located on the central coast at the intersection of two major highways, is the largest of the case communities with the largest port and most diverse commercial fleet in Oregon. It has a relatively vibrant and diversified economy that has shifted toward marine research and education and tourism industries, while maintaining a focus on fishing.
5. Depoe Bay is a very small community along the central coast that was historically focus on commercial salmon fishing and has now diversified into ocean tourism, specifically charter fishing and whale watching.
6. Garibaldi, the smallest of the case communities, is an economically stressed fishing village located along the northern coast

with little diversification that has shifted from fishing, lumber, and dairy industries to tourism, specifically charter fishing and whale watching.

3.3. Data collection

Data for the case studies were gathered through semi-structured interviews with snowball samples of community members from diverse social groups and organizations in each of the six communities. Open-ended interview questions elicited data about community members' understandings of (1) external stressors that affected the community in the recent past, (2) socioeconomic and environmental impacts, (3) community responses, and (4) factors that enabled and constrained response. The term "climate change" was avoided because of its controversial nature in rural politically-conservative areas in the US, although the follow-up questions in the interview protocol did probe communities' experiences with and responses to climate change-related stressors such as natural hazards and declines in productivity and health of biological systems. A total of 71 interviews were conducted for the study, approximately 12 in each community. Informants represented a range of stakeholder groups, including local social service and fisheries and marine resource management and conservation agencies and organizations, and occupational groups such as fishers and tourism operators. The interview data from Garibaldi were supplemented by six interviews previously conducted with the fishers in that community. The interviews took place in the homes and workplaces of the key informants and lasted on average one hour each.

3.4. Data analysis

Data were analyzed qualitatively with the technique of cross-case synthesis (Yin, 2009). Analytical memos were developed simultaneously with data collection. Analytical memos were drafted after the completion of each interview and community case to summarize what was learned through the interviews and document preliminary insights into the research questions (Miles, Huberman, & Saldana, 2014). Interview recordings were then transcribed verbatim. Qualitative content analysis of the interview transcripts was conducted (Schreier, 2014) aided by NVivo data analysis software (QSR International Pty Ltd., 2012). Data were segmented, and quotations that conveyed meaning about the interview questions, overarching research question, and any emergent themes were identified. A framework of descriptive, process, In Vivo, and pattern codes (Miles et al., 2014) (Table 2) was applied to all 71 interview transcripts to identify sections of transcript text that characterized informants' perceptions of salient

Table 1
Case communities.

Community	Garibaldi	Depoe Bay	Newport	Florence	Port Orford	Gold Beach
Location	North coast	Central coast	Central coast	Central coast	South coast	South coast
County	Tillamook	Lincoln	Lincoln	Lane	Curry	Curry
Population, 2014*	2250	1398	10,400	9466	1100	2250
Proportion of population living below poverty level, 2014*	19.60%	16.90%	18.50%	17.10%	31.70%	19.50%
High school graduation rate, 2014 (county-level)**	83.90%	70.84%	69.41%	66.67%		
Personal income contributions from fisheries, 2003 (county-level, millions)	\$6.10	\$54.80	\$1.10	\$12.20		
Personal income contributions from forestry, 2003 (county-level, millions)	\$74.80	\$60.10	\$13.70	\$40.00		
Personal income contributions from tourism, 2003 (county-level, millions)	\$23.50	\$89.90	\$19.20	\$24.00		
Industry employment in agriculture, forestry fishing, hunting and mining, 2014**	8.45%	0%	4.59%	1.33%	17.93%	1.74%
Industry employment in agriculture, forestry fishing, hunting and mining, 1990**	15.54%	6.49%	6.10%	4.78%	22.92%	10.14%

* American Community Survey (ACS), 2014.

** Communities Reporter Tool, Url: <http://oe.oregonexplorer.info/rural/CommunitiesReporter/Explore>; Data source: US Census Bureau: Decennial Census (1990, 2000); American Community Survey (2005–09 forward) (Accessed 05/17/17). Some statistics for Newport and Florence, and Gold Beach and Port Orford, were only available in aggregate because of the communities' proximity and location in the same county.



Fig. 1. The Oregon Coast and case communities.

external stressors that had affected their community, impacts of the stressors, how the community responded, and key factors that engendered different types of response. The communities were then compared and contrasted, aided by word tables (i.e., matrix displays) that distilled the data for each code and a conceptual model that related the codes to each other (see results section) (Miles et al., 2014; Yin, 2009).

4. Results and discussion

4.1. Primary external stressors experienced by Oregon's coastal communities

The six communities had experienced a range of stressors, the most salient of which were socio-economic (Table 3). Most of the stressors were interrelated and cumulative. Interestingly, natural

hazards were not of great concern to the interview informants, and climate change per se was not mentioned.

Decline of natural-resource-based industries: When asked about the major changes that had challenged the community in recent years, informants expressed concern primarily about socio-economic decline, poverty, underresourced governance institutions, and aging infrastructure (Table 3). Decline of commodity-based industries was the single greatest stress on the communities from the perspective of the interviewees. In each community informants described steep declines in timber harvests from public lands as a result of federal policies, enforcement of stricter rules on private timber harvest, and industry and market shifts that resulted in mill closures and job losses, all trends supported by the literature (Chen & Weber, 2012; Freudenburg et al., 1998). Similarly, informants described the collapse of several fisheries and the enforcement of stricter rules on fishing and harvest of marine resources that has

Table 2
Coding framework.

Code type	Coding method	Code	Explanation
Codes based on interview and research questions	Descriptive	Stressor	Major challenges this community has faced over the last 10–15 years
	Descriptive	Impact	How the stressor originated or became a problem in the first place; how the community was impacted; who was affected; what made the community susceptible to being affected
	Process	Response	Actions that individuals, social groups or organizations in the community engaged into respond to the changing situation; decision making processes; ways in which community organized internally itself to address challenges; ways the community reached out to get information or resources from the outside
	Descriptive	Enabling Factor	Reasons community responded in the ways that it did; opportunities that presented themselves and ways the community took advantage of them
	Descriptive	Constraining Factor	Reasons community responded in the ways that it did; barriers the community faced in responding; reasons the community was not able to overcome them
	Pattern	Stressor interactions Stressor-response interactions	Co-occurrence of stressors and responses in interviewees descriptions of how the community experienced and responded to external stressors
Modifier codes	Descriptive	In Vivo	e.g., “Making Do with Less” Words or short phrases informants used to describe specific categories of stressors, impacts, responses, and enabling or constraining factors
		Education Fishing Timber Policy Changing demographics Tourism Natural Phenomena	Types of stressors and impacts; sectors and social groups in which community responses occurred; types of preexisting conditions, stressors or impacts that in and of themselves became enabling and constraining factors

Table 3
Salient external stressors and impacts on communities.

External Stressor	Impact	Garibaldi	Depoe Bay	Newport	Florence	Port Orford	Gold Beach
Decline of the timber industry	Loss of family wage jobs leads to exodus of workers and identity crisis; loss of funding from timber receipts	X			X	X	X
Decline of the fishing industry	Diminished income and fewer jobs; increased travel time and costs; loss of resources to support fishing infrastructure	X	X	X		X	X
External policy interventions	Strained relationships and alienation	X	X	X		X	X
National economic recession	Decreased revenue; housing market decline	X	X		X		
Demographic change	Increased demand on services; different needs, desires, and perspectives; increased housing prices	X	X	X	X	X	X
Natural hazards	Damage to infrastructure; increased maintenance costs			X	X		

made fishing and associated industries less profitable and viable as a profession. The result was a decrease in community economic vitality and well-being. A community member from Garibaldi explained the current depressed socioeconomic conditions as a legacy of natural resource dependence:

I think that has to do with this area having been founded on extraction-based industries—primarily logging and fishing, to a lesser degree mining. And those industries, because of several competing factors, just don't produce the income or wealth in the coastal communities like they had in the past, and I think maybe we've been a little slow to adapt or change to those changing conditions.

As the former working class has migrated to urban areas, young and elderly residents, along with many empty houses, have been left behind. “Everyone left; people split,” recounted a community member in Florence. “There was no work. I mean, if you could get a job at the [grocery store], you were totally happy. The guy that grew up on the river shooting cormorants and delivering mail—he bought the hardware store and then sold it, [but] there was nothing to replace it.”

External policy interventions: Although resource depletion was recognized as a factor in the decline of commodity-based industries, many interviewees blamed a political system that was overly centralized and that privileged urban populations who did not understand local social and ecological impacts of the decisions to regulate extraction. The result was a complex set of rules and regulations with unintended consequences. Informants also complained how decision makers failed to engage the public who could help. For example, a community member from Gold Beach asserted that overemphasis on tsunami preparation complicated local waterfront revitalization efforts:

[A catastrophic tsunami] happens in Japan. We see it on TV—it's horrific. . . So now we need to come up with legislation over on this side of the ocean. You've solved one problem, but now you've created a whole other one. It's sort of like “We're the government; we're here to help you!”—“Okay, but now you're making a whole other problem that you didn't even consider, because you didn't ask!”

The increasing burden of navigating rules and regulations reduced the viability of the already decreasingly profitable fishing

sector as profession for many. A resident of Newport described the complex set of policies that govern use of marine resources: “A lot of the regulations the fishermen have to meet are duplicative. So they’ve got a federal regulation, a state regulation, a coast guard regulation, and an ocean regulation. And all four of them will be slightly different.”

National economic recession: Compounding the economic legacy of the collapse of forestry and fishing, the economic impacts of the Great Recession of 2008 were also of concern. It was widely thought that the national economic decline had affected local government budgets and business profits, resulting in deterioration of local public and private infrastructure, social services, wages, and social well-being. “The collapse of the housing market took away high-quality paying jobs,” explained a community member from Florence. “We probably had 12 or 15 or more builders in town... Some of them retired, some of them quit or went into a different trade, and some of them moved out of the area where things weren’t quite as distressed. It had huge impacts on our community.” It is well documented that the recession had substantial impacts on rural natural resource-dependent communities (Chen & Weber, 2012).

Demographic change: National trends in amenity migration and the associated influx of retirees and gentrification of areas popular with tourists and weekenders were also considered a major source of stress, although informants also acknowledged new opportunities that this influx created. Informants perceived that the influx placed pressure on local housing stocks in price ranges suited for the middle class. They also felt that the influx caused social conflict within communities over local policies regarding taxes, schools, and social services. In general, longtime residents perceived that in-migrants with substantial assets were not as vulnerable to or invested in local budgeting and planning. The wealth inequality associated with the combination of economic decline and influx of retirees and tourists was perceived to be a barrier to attracting new living-wage families and maintaining a balanced and stable demographic. “There seems to be a vanishing middle class, in that you’re either retired and have money from elsewhere or you’ve been here your whole life. There is not much economic opportunity, not much opportunity for new people to come in and make a living,” said a community member from Florence.

Natural hazards and climate-related changes: Natural hazards were mentioned as a major concern in only two communities, Newport and Florence, which was surprising given that the entire Oregon coast is located within the Cascadia subduction zone, and that coastal natural hazards are a major policy concern at the state level (Wood et al., 2010). Despite being aware of the tsunami risk, interviewees felt that little could be done to address it short of relocating outside the coastal area, because the magnitude of the event would be so great. An interviewee from Florence demonstrated a mix of concern and abnegation about a tsunami resulting from an earthquake along the Cascadia fault: “I see it as a real concern. I mean Florence will just be gone. We won’t even need to worry about it.” Similarly, a public employee in Depoe Bay explained that the residents in his community were prepared but not concerned:

People visiting the community are probably more stressed about the idea of a tsunami than those of us that live here. Newcomers come in and ask, “Oh, do you have a tsunami evacuation map?” but not people that have been here for any period of time.

Small hazard events such as coastal storms were more likely to affect coastal communities in the eyes of the interviewees, and more because of effects on public road and infrastructure maintenance costs than the risks to human life and private property.

Despite widespread recognition of climate-related stressors by external agencies and institutions, the interview informants did not mention climate change in response to the interview questions about the major challenges their communities had been facing in recent years, and few identified any of its reported and projected local manifestations as serious challenges. Very few community-level key informants expressed concern about increasing storm intensities, coastal erosion, and flooding that may come with climate change, and none appeared to be concerned about impacts of increasing temperatures and acidity of seawater. Of much greater concern were threats to economic solvency and social well-being. “I care about the environmental stuff, and those things are really big deals,” said a social services employee from Florence about natural hazards. “But at the same time, people are coming in [to the shelter] and saying ‘I need a meal.’ [That is] what comes first: feeding, clothing, and jobs.” Slow-onset stressors such as climate-related changes are difficult to observe as they unfold. Moreover, chronic everyday problems, including those related to the maintenance of livelihoods, or consequences of inadequate livelihoods, often eclipse more remote yet potentially more destructive threats (van Aalst, Cannon, & Burton, 2008). People may also not prioritize such threats because they have become accustomed to living with them, or feel powerless to change the circumstances of daily life. Shared experience of stress can lead to social cohesion and altruistic norms within communities (Drabek, 1986; Dynes, 1970) and in some cases engender “therapeutic communities” in which members come together in mutual support and, at times, fatalism or denial of threats (Cuthbertson & Nigg, 1987; Dynes & Quarantelli, 1971).

4.2. Responses to external stressors

The communities responded to external stressors with a range of strategies (Table 4) that can be viewed as sequences of decision points, or pathways (Figure 2). Some of these responses were more adaptive than others in that they provided more adequate adjustment to the changing socio-economic and natural environment from the perspective of the interview informants. Some responses could be characterized as maladaptive.

Relocation: Informants from all communities except Newport asserted that members of their communities have left for other geographic regions with greater economic opportunity and social vibrancy, especially in the decade following the collapse of forestry and, later, fishing (Fig. 2). “We see a lot of people leaving town when they graduate high school,” observed an informant from Florence. “It is not so much that they don’t want to stay here, it is just that there are not a lot of options that would allow them to stay here.” Some interviewees attributed this behavior to general feelings of hopelessness and apathy that had settled into communities, in part due to perceived lack of alternatives and means of overcoming conflicts and impasses. Other community members who maintained their residences in the coastal communities nevertheless sought important services elsewhere, including health care, shopping, education, and entertainment, thereby contributing to the vitality of other communities besides their own. “There are a large number of people, they will drive once a week to Coos Bay and do their grocery shopping at Walmart. And they will do it for friends, family, and just bring everything back,” explained an informant from Port Orford. Although relocating and obtaining goods and services outside a community can in some cases be adaptive responses to declining socioeconomic vitality within the community, such adaptation behavior can also be less than optimal, perhaps even maladaptive, when it subtracts from local human and social capital (McLeman & Smit, 2006; McLeman & Hunter, 2010). “Our school, the high school, used to have close to 400 kids

Table 4
Community responses to external stressors.

Response	Examples	Garibaldi	Depoe Bay	Newport	Florence	Port Orford	Gold Beach
Relocation	Migration; external production and sourcing of goods and services	X	X		X	X	X
Resource-seeking	Alternative sources of revenue through taxes, grants, subsidy programs	X	X			X	X
Make do with less	Shedding services; merging departments; stretching budgets; engaging volunteers	X	X	X	X	X	X
Improve livability to attract families	Urban renewal; improving health care and social services; natural hazards mitigation		X	X	X		
Economic diversification	Developing tourism and retirement sectors; local fisheries	X	X	X	X	X	X

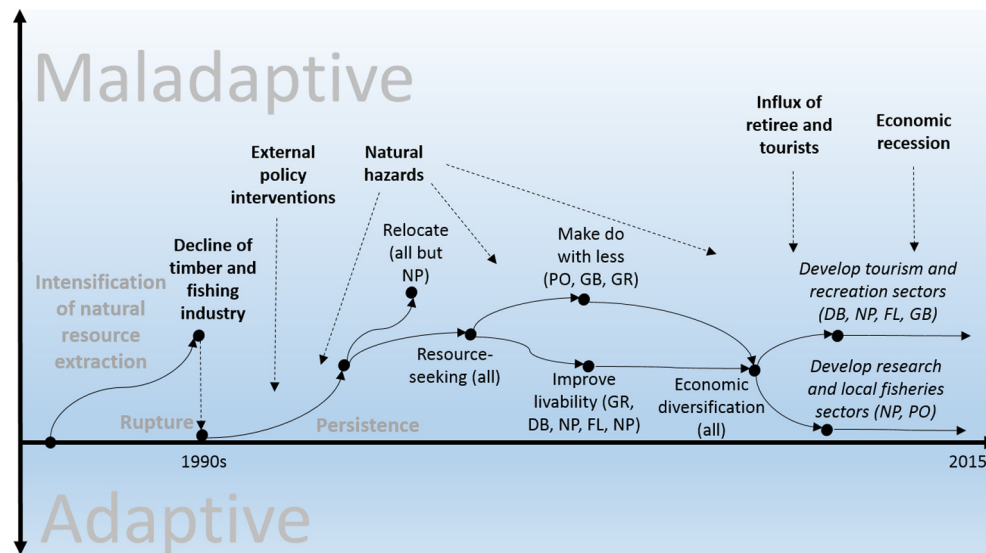


Fig. 2. Pathways of adaptation to climate change and other external stressors in Oregon's coastal communities. Stressors are indicated by bold font and dotted arrows; responses are indicated by normal font and solid arrows; stages in pathways are indicated by grey font. GR = Garibaldi, DB = Depoe Bay, NP = Newport, FL = Florence, PO = Port Orford, GB = Gold Beach.

in it. This past week, the graduating class had thirty-some,” said an informant from Gold Beach.

Resource seeking: Once communities came to terms with the long-term nature of timber and fishing's decline, they began looking for new resources (Fig. 2). To mitigate poverty and the declining revenues from timber receipts, local governments sought out sources of financial revenue beyond local property taxes, which were locked at low levels. Attempts were made in some communities to raise low property taxes or pass other levies. In Gold Beach these levies were almost entirely unsuccessful, whereas in Florence the community passed several levies. Members of Gold Beach also lobbied, though unsuccessfully, to pass a state bill that would change the minimum property tax, in an attempt to increase county government funds and circumvent opposition to tax increases by other local community members. All six study communities undertook lobbying efforts to oppose regulations and policies that, in their view, unjustly restricted harvest, limiting their resource base. Communities also lobbied the federal government to create and maintain a payments program to compensate historically timber-dependent counties for the loss of receipts from timber harvests on federal land.¹ However, some community members did not consider the program an adaptive response to generating funds for public safety and other county services. An informant from Port Orford explained that the payments “do more damage

than good, because when the government throws us a little money, everybody thinks the problem is over. So they defeat the issues at the ballot box, and it hurts us more than it helps us.”

The decline in the fishing industry made it difficult for port authorities and communities to maintain infrastructure for fishing. These entities looked for alternative funding sources. In Florence, Newport, and Garibaldi the ports used recreational vehicle parks to generate some of this funding. Depoe Bay considered transferring its municipally owned port to a port authority to enable it to generate taxes to support the fishing infrastructure. Communities also lobbied for federal support for infrastructure improvements. Port Orford was able to secure funds for its own dredging equipment through these efforts, and Garibaldi successfully sought commitment from the Army Corps of Engineers to maintain its jetty. Communities also sought funds by creating partnerships with external nonprofit organizations and agencies to secure public and private grants and other sources of financial assistance. For example, Port Orford assembled a network of local and nonlocal volunteers and advisors to find support for their efforts to promote sustainable fisheries and protect marine biological diversity. Despite the various strategies employed in these communities, making ends meet at the city and county level continued to be a struggle. Securing resources is often considered a reactive adaptation strategy, and one that is not particularly adaptive (Berrang-Ford et al., 2011; Fazey et al., 2010). In the case of Oregon's coastal communities, resource-seeking could be viewed as coping rather than adaptation in the strict sense since it did not appear to improve the welfare of the communities.

¹ The Omnibus Budget Reconciliation Act of 1993 and the Secure Rural Schools [SRS] and Self Determination Act of 1999 [H.R. 2389].

Making do with less: Eventually, some communities attempted to make do with less (Fig. 2). Garibaldi, Gold Beach, and Port Orford decreased expenses by shedding services, combining departments, refinancing debt, and stretching budgets. Curry County, in which Gold Beach is located, discontinued several services to make do with the limited funds. “The county spun off home health and hospice... to a private nonprofit and then spun off mental health and public health to a private nonprofit too,” said one resident. Local governments also privatized and created special districts for services. In some cases new organizations were established to address problems beyond the capacity of existing government departments. For example, residents of Port Orford created a night watch program in response to increasing crime rates associated with a reduction in the capacity of the county jail. “It was very effective,” one resident said of the program, “to the point where, from my understanding, there has only been one robbery since January now, and they were getting them almost daily before.” As with securing resources, spreading risk can be considered a reactive adaptation strategy (Berrang-Ford et al., 2011; Fazey et al., 2010). Although in some cases scarcity led to resourcefulness, as with the night watch program, four of the six communities—Port Orford, Gold Beach, Depoe Bay, and Garibaldi—lacked the resources to provide basic services and maintain infrastructure. In other words, making do with less proved to be an inadequate adjustment to the stressors the communities were experiencing, perhaps even maladaptive.

Improving livability to attract new residents: Some communities made efforts to improve livability to attract and retain additional residents, especially families, despite the lack of jobs (Fig. 2). For example, Garibaldi, Florence, Newport, Depoe Bay, and Gold Beach launched urban renewal initiatives to attract businesses or new residents. Under the initiative “A City in Motion,” Florence stimulated economic growth by creating an economic development team and an arts committee, investing more heavily in marketing, and reallocating a portion of the tourist tax monies to the chamber of commerce. Communities also made efforts to improve or maintain services, such as health care and after-school activities. Florence and Newport launched initiatives to expand housing and make housing more affordable. Although attracting retirees increased communities’ population and tax base and infused communities with new skills and knowledge, the resulting wealth inequality and social conflict constituted new stressors. For example, a Port Orford informant explained, “Not everybody is cut out for tourism. People want to fish, be left alone, do their job, and go home at the end of the day and not deal with people.” When several state and federal agencies provided funds to transform a Port Orford highway wayside into a park that was attractive for visitors, many residents were unhappy with this use of scarce resources. “There were people, when it was all done, that said that they would donate the equipment to bulldoze the wall,” said one resident. The strategy of improving livability can disrupt continuity of place attachment and livelihood practices, which are important components of cultural identity (Adger, Barnett, Brown, Marshall, & O’Brien, 2013). Although efforts to attract new residents could have made the communities better off, the social conflict that ensued compromised the welfare of some social groups, therefore reducing adaptiveness.

Another way communities sought to improve livability was to address physical exposure and deteriorating infrastructure in the face of natural hazards. Some local governments developed natural hazard mitigation plans and removed dikes and levees to mitigate erosion and reduce flooding. Such efforts to manipulate biogeophysical conditions to make them less hazardous can be considered minimally adaptive because they constitute short-term change in an external system to make self-regulation unnecessary (Thomsen et al., 2012). Communities also undertook emergency

preparedness measures. They built bunkers and created trauma units to improve response to tsunamis and severe storms. Gold Beach, for example, approved and levied funds from the local tax base to construct a new hospital to address the needs of the expanding aging population and prepare for potential disasters. Community members were generally pessimistic about their ability to do anything to truly prepare for a potential earthquake or tsunami. The exceptions were Newport and Florence, which undertook substantial planning efforts to prepare for a potential natural disaster—“when the big one comes, the bridges are gone, all the roads are gone, and they are predicting that we will be without anything for up to three weeks,” explained an informant from Newport. In response Newport developed plans for emergency response and established tsunami warning sirens and evacuation plans. A community of ham radio operators trained regularly to fill potential communication gaps. Depoe Bay made minor preparations, installing sirens and trauma units. While these activities were not adaptive in the sense of making the communities better off than they were in the past, they reduced the risk of adverse effects.

Economic diversification: All six communities explored developing alternative economic sectors to compensate for the decline of forestry and fishing (Fig. 2). “If you’re gonna be in a business on the coast, you have to be diverse. That’s the bottom line,” explained a community member from Depoe Bay. The communities diversified their economies beyond commodity-oriented fishing and forestry to include value-added processing, tourism, and the arts. Communities attempted to attract new businesses and families to the area through urban renewal projects, infrastructure improvements, and other community enhancements. Florence, notably, actively sought to attract retirees as a response to fill the need left by the timber and fishing industries. Newport attracted scientific research and educational institutions. Some communities underwent creative reinvention, developing tourism as a major economic sector and source of community identity, offering programs and events to enhance community vitality and cohesion, and incorporating urban renewal and tourism components into local government structures. In Depoe Bay, whale watching partially took the place of reduced fishing opportunities. While tourism created some jobs, the below-family-wage compensation for these jobs limited their impact and the sustainability of communities’ investment in this endeavor, although it stemmed decline in welfare. Communities also did what they could to keep forestry and fishing alive by diversifying within these sectors and engaging in legal and political responses to natural resource policies they viewed as problematic or unfair. Within the fishing industry, decline led to adaptation. Some fishers began to utilize different fisheries or traveled to other ports. Some communities, like Port Orford and Garibaldi, sought markets for fishermen to sell fish directly to customers through community supported fisheries.

4.3. Factors that influence response to external stressors

When asked for their perspectives on their responses, particularly opportunities that presented themselves and they took advantage of them, and barriers they faced and reasons the community was not able to overcome them, informants referred to four main types of factors (Table 5) that interacted with and reinforced each other. From a pathways perspective, the responses can be viewed as part of a broader societal transition within a context of interacting cultural, political, economic, and environmental change. The communities’ responses constitute key junctures that influence the direction of change (Fazey et al., 2016; Wilson, 2014). Historically, the communities exploited the area’s rich natural resources as their primary economic pursuit. Given their local ecological knowledge and skills, the communities were likely quite

Table 5
Factors in response to external stressors.

Factor	Examples	Garibaldi	Depoe Bay	Newport	Florence	Port Orford	Gold Beach
Disrupted continuity of place and livelihood practices	Unwelcomed transition from fishing and forestry to tourism and retirement-oriented services	X	X	X	X	X	X
Geographic isolation	Remote location; lack of connectedness to transport, economic and political networks	X	X			X	X
Lack of resources	Joblessness and poverty, small tax base	X	X	X	X	X	X
Lack of access to resources	Sparse social and political networks and weak ties	X	X	X	X	X	X

adept at navigating minor environmental perturbations. However, the decline of the timber and fishing industries in the latter part of the 20th century greatly disturbed the social and economic fabric of Oregon's coastal communities. The decline of these industries can be considered a rupture (Fig. 2) in the transitional pathways of the communities (Wilson, 2012). Migration by many young community members, for lack of other livelihood options, depleted the human and social capital of the communities. The lack of diversity in the communities' local economies, their geographic isolation, and their lack of integration in regional economic, social, and political networks may have constrained options for communities to negotiate change and rebuild capital, limiting the number of possible pathways to follow after this rupture (Wilson, 2012).

Disrupted continuity of place and livelihood practices: Disruption of continuity of place and livelihood practices restructuring relationships with a resource-base can cause financial and emotional stress and weaken social networks (Adger, Barnett, Brown, Marshall, & O'Brien, 2013). Outmigration of community members in the wake of the collapse of timber and fishing combined with national demographic trends of tourists and retirees moving from cities and suburbs to amenity-rich coastal areas were a major structural force shaping the communities, causing financial and emotional stress and weaken social networks (Adger et al., 2013) and rendering them poorly positioned to pursue a collective vision and goals—particularly in Florence, Depoe Bay, and Port Orford. At the same time that cultural identity can foster collective action (Adger et al., 2013), collective social memory, formed through a long history of attachment to place and occupational identity, can also create social conditions that resist change and thus can contribute to path dependency (Wilson, 2014). The strong cultural identification with timber and fishing was recognized as a challenge to the ability of Oregon's coastal communities to consider other pathways. “We're really becoming more of a retirement community,” observed an informant from Port Orford. “But a lot of the old kind of people still long for the old days where we had a driving natural resource economy, and that just doesn't happen anymore.” An informant in Garibaldi suggested, “Change comes slowly. Frankly, we've got some folks that are really set in their ways, and it explains why we do things like we do, because we've always done them this way. There's a saying here that change comes one funeral at a time.” The result can be a locked-in social-psychological feedback loop of conservatism, lethargy, and inertia (Wilson, 2014). This tendency toward conservatism is especially strong in rural natural-resource-based communities with utilitarian orientations (Wilson, 2007). “People that have lived here for a long time have a different outlook on life,” explained an informant from Depoe Bay. “We're independent—fiercely independent. You hear about disasters that happen. Here, we know the emergency responses in the Valley are not coming to help us, so we have to take care of ourselves. That's just the way we live our lives and everything else.” In several of the communities, discontent with this disruption led to a pattern of blame and resentment toward the federal government for undermining a historic way of life may have prevented residents from taking advantage of new

opportunities. “To turn against the way of life they've known, there has to be a guilty party: there has to be somebody to blame,” explained an informant from Gold Beach. “And it's really easy to blame the government here. They took away this O&C² money. It's not the [community's] fault that they're unemployed. It's the government's fault. It's those bad people. So one of the problems you have here is it's hard to get the problem fixed with the people that live here because they don't want to change.”

Geographic isolation: Many of the interview informants described their geographic isolation and lack of access to information and resources as formidable barriers to increasing social and economic vitality. Indeed, informants from Newport, the most vibrant of the six communities, said the community owed its vitality, in part, to its proximity and connectedness to larger population centers in the Willamette Valley, such as Portland, Salem, Corvallis, and Eugene.

We are as connected to Lincoln City, believe it or not, as to Corvallis. And that's because of that little Highway 20 [which connects Newport to Corvallis] and the bay [which separates Newport from Lincoln City]. And because of having that connection and the bay and just because it's in the central part of the state, it literally is almost right in the center. There was a chance to become a city. Newport's not a coastal town—a coastal town is Depoe Bay, and they now rely entirely on tourism.

Pathways can become locked in because of conditions beyond the control of individual communities. Examples of such structural lock-ins include geographic isolation and lack of connectedness to transport, economic and political networks, and external demographic trends and policy decisions (Wilson, 2014).

Lack of resources: Lack of economic resources in particular locked several communities into stagnant paths. The decline of timber and fisheries not only resulted in joblessness and poverty among community members but also left local governments with few financial resources to maintain infrastructure and provide services. Viable rural livelihoods depend on the relative success of community members to sustain and increase their access to resources and make use of resources for their benefit (Bebbington, 1999). A lack of resources to support governance structures and processes can undermine communities' abilities to adjust to changes by modifying social norms, behaviors, and policies, and implementing adaptation decisions (Adger, 2003; Magis, 2010; Nelson et al., 2007; Norris et al., 2008). Without thriving industries, Port Orford, Gold Beach, and Garibaldi were unable to secure funding from federal agencies for port repairs. In many instances, communities were faced with tradeoffs between responses that would address short-term versus long-term needs. In the case of Gold Beach, the community decided to rebuild the

² O&C refers to Oregon and California Railroad Revested Lands, 2,600,000 acres (1,100,000 ha) of land located in western Oregon once owned by the Oregon and California Railroad and now managed by the Bureau of Land Management, in part to provide a source of income for schools and county services for the counties that they cross.

hospital in the tsunami inundation zone rather than face the seemingly unsurmountable challenge of locating it on the steep surrounding hillsides. A representative of a state agency was exasperated: “What’s ridiculous is expanding the hospital in the inundation zone because when you’re going to need it most is after the earthquake and tsunami and now it’s underwater and not functional.” Yet many of the people of Gold Beach believed they had no other option given available resources. Community members lamented the lack of availability of support for taking action to address problems, complaining that most state and county funding was for research and long-term planning. For example, when asked about the barriers to addressing the threat of coastal erosion to the local road network, the city superintendent of one of the communities said:

We don’t have the funding right now; the only money that’s available out there right now is for studies. You can go to the state or you can go to the federal government, and there’s grants, there’s hundreds of grants you can get, but a lot of them are just studies of things. You can’t really get brick-and-mortar stuff. It’s just not there. We’ve tried.

Lack of access to resources: Interviewees perceived that their communities were adversely affected by their lack of access to policy processes and the resources that enable influence. They felt that policies determined by populations far removed from life on the coast had left community members without a sense of self-determination. “What works for Portland does not work for Gold Beach,” lamented one informant. “We feel we have no representation in the state. Our voting power is limited because there’s only 22,000 people [in the county],” said one resident. Similarly, some community members in Gold Beach and Port Orford described the county payments program as a contributor to a structural lock-in. They reported that the county payments policy, albeit one of their few economic lifelines, created dependency on the federal government and allowed communities to hold out hope that the timber industry might return. The ability of people to increase their access to resources via social and political networks is critical to their ability to thrive (Bebbington, 1999). The communities’ physical and social remoteness to decision-making networks limited their ability to shape policy for their benefit. Community members also perceived a mismatch between state and regional actors’ priorities and those of small coastal communities. Whereas state and regional actors aim to protect populations from major threats (e.g., natural hazards and climate-related changes) that may occur in the future, local communities were engaged in day-to-day struggles. Without sensitivity to local conditions exogenous policy interventions, intended to increase capacity, can exacerbate current socioeconomic problems (Thomsen et al., 2012). This mismatch may have had to do with inherent differences in the scope and scale of planning and action—state and regional actors are likely concerned with developing plans and actions for a longer time period and larger geographic areas than the communities, whose priorities were about addressing pressing immediate problems. A community representative of Gold Beach found the incongruence between big-picture focus of state and regional actors’ adaptation activities with the unmet basic needs of many community members demoralizing:

When I go outside the area to meetings, they’re talking about all these projects that are going on and things that are going on. They’re, like, “Oh, we have visioning and we have this long-term plan.” It almost makes you want to cry, because it’s, like, we are, like, just trying to survive. Forget about visioning. We’re just trying to survive. You can’t talk about what-ifs when you’re trying to feed yourself.

Interacting stressors and cumulative pressures: The state of being locked into historical natural resource orientations is not surprising, given the social tendency to not abandon a course of collective action after great investments have been made in that course of action (Wilson, 2012). In Gold Beach, Port Orford, and, initially, Florence, reliance on county payments to ride out economic hardship may have precluded a rebuilding of human, economic, and social capitals, as may have Depoe Bay and Garibaldi’s continued focus on fishing despite its decline. Florence attempted to rebuild these capitals by shifting its economy toward tourism and retirement, alternatives that often come with costs, such as compromised notions of community in the geographic sense, declines in neighborly relationships and trust, and, at times, moral bankruptcy (Granovetter, 1985; Pretty & Ward, 2001; Wilson, 2012). With the exception of Newport, and to some extent Florence, the small historically natural-resource-dependent communities faced chronic economic and social stress. At the time of this study these chronically stressed communities—Gold Beach, Port Orford, Depoe Bay, and Garibaldi—had not been able to overcome the persistent poverty, loss of the working middle class, and strained public services and infrastructure that characterize many small historically natural-resource-based towns. These interacting stressors created cumulative pressures (Smith et al., 2013) resulting in unemployment, underfunded school systems and local governments, failing infrastructure, and diminished well-being. Major losses in human, economic, and social capital, along with a growing sense of futility, likely limited communities’ capacity to respond to stressors by transitioning onto more adaptive pathways. Although Newport has managed to attract scientific research and educational institutions and Florence transformed itself into a tourism and retirement destination, Gold Beach, Port Orford, and Garibaldi appeared to lack access to resources and political power, and the capacity to shift onto more adaptive trajectories. For the most part, the communities collectively perceived they were on the verge of crossing a threshold of vitality from which they would not be able to return. Communities with such conditions struggle to maintain and develop organizational capacity to resolve problems and take advantage of new opportunities (Walker et al., 2002; Adger, 2003; Brown & Westaway, 2011; Buikstra et al., 2010; Cutter et al., 2003).

5. Implications for climate change adaptation

The six coastal communities of study were vulnerable to climate change. They were exposed in that they were likely to be affected by climate change because of their location in areas projected to experience storm surge, sea level rise, ocean acidification, and habitat degradation. They were also sensitive in that they were likely to be harmed by climate-related hazards and ecological changes because of their reliance on industries that could be negatively affected by climate change (i.e., fishing and tourism) and lack of resources necessary to recover from stress and invest in taking advantage of new opportunities. Although the communities’ responses were not adaptive in the strict sense of the term, they demonstrated ability to cope with stress and disturbances that result from social, political, and environmental changes, and employed a range of strategies for maintaining their functional roles as communities under conditions of chronic resource scarcity.

Use of a pathways lens enhances understanding of past change and response dynamics: how and why changes and responses have occurred, the different ways that different groups have perceived, responded to, or navigated change, and the contextual issues (e.g. politics, social norms, values) that affect change dynamics. A pathways lens also provides insights about how responses to change might occur in the future. Given that access to resources is a

well-recognized factor in viable rural livelihoods (Bebbington, 1999), resource scarcity may be a critical determinant in whether and how coastal communities address increasing sea levels, coastal storms, erosion, and ocean acidification in the future. Informants in the six coastal communities of study attributed their marginal status to the interacting factors of geographic isolation, lack of internal resources and lack of access to external resources. The communities' experiences of being constrained by these factors may signal their ability to adapt to climate change as well. Similarly, informants perceived that disruption in continuity of place and livelihood practices diluted their collective identity and ability to act collectively. Given that the coastal communities of study have already experienced outmigration and dramatic changes in their structural relationships to forests and fisheries, behavioral adjustments required for adaptation to climate change may not be so great. Nonetheless, social capital in the communities has been diminished, which may make collective action and learning to take advantage of new opportunities difficult.

Examining Oregon's coastal communities' past experiences through a pathways lens suggests a need to rethink current climate change adaptation approaches. State agencies and state offices of federal agencies have outlined recommendations for climate change adaptation along the coast that do little to address root factors in community vulnerability. The priorities for adaptation to date include increasing public awareness and understanding of climate change effects, developing frameworks and processes for adaptation planning, increasing research on the impacts of climate-related changes, assessing natural hazards, developing long-term state and local adaptation strategies, and guiding and engaging the public in adaptation planning.³ This top-down approach ignores the different scales on which local communities perceive and respond to external stressors and the spatial and temporal relationships among the interacting and cumulative pressures and responses (Smith et al., 2013; van Aalst et al., 2008). A lack of deliberate coordination of endogenous and exogenous adaptation may allow existing vulnerabilities to persist and deny communities opportunities to take advantage of adaptation options. Moreover, some adaptation actions initiated by state and regional actors may exacerbate existing vulnerabilities. The disconnect between the state's adaptation goals and practices and the priorities of small coastal communities may be a major barrier to efforts to prepare for climate change. Under conditions of chronic stress and resource scarcity, these populations may be unable and unwilling to make behavioral changes that incur near-future costs and burdens to reduce far-future exposure and sensitivity. Indeed, county governments were expected to prepare adaptation plans by 2015 to account for the effects of climate change yet only two of Oregon's seven coastal counties had completed an adaptation plan at the time of this study. Although this is unsurprising given that anticipated climate change is rarely the sole primary motivator for adaptation—extreme events have tended to be important catalysts for many adaptation actions (Wise et al., 2014)—it also raises questions about the efficacy of the approach.

From the pathways perspective, adaptation should ideally proceed on two tracks: (1) continuing existing predominantly incremental actions (within prevailing governance arrangements) to adapt to climate change, but modifying them to ensure that they are informed by an understanding of systemic change; and (2) understanding the influence of existing rules and values on framing and decision making, and how these rules and values can be changed to better enable society to guide systems onto more desir-

able pathways in the context of global change (Wise et al., 2014). To be most effective, adaptation should concentrate on removing the ultimate drivers of undesired changes, maintaining or increasing the diversity of future response options, and nurturing and building human capacities to take up response options (Fazey et al., 2010).

The pathways approach suggests a participatory approach to assessing options for climate change adaptation that are grounded in local conditions. (Fazey et al., 2010; Wise et al., 2014). Participatory vulnerability assessments facilitate recognition of multiple stimuli—political, cultural, economic, institutional and technological—and changing interactions among exposures, sensitivities and adaptive capacities over time (Smit & Wandel, 2006; van Aalst et al., 2008). As such, they provide a means to fostering local adaptation to climate change that is focused on reducing vulnerability, improving livelihoods, and building adaptive capacity. Participatory adaptation planning stresses endogenous-exogenous assessment processes in which outside resource providers work closely with local stakeholders to evaluate current vulnerability to climate change and existing adaptation strategies, policies, and measures based on actual experience at different scales (van Aalst et al., 2008). Before assisting communities with developing adaptation plans outside resource providers should ask the following questions: Do the affected communities have access to and can they afford the technology needed for adaptation? Are they receptive and motivated to make necessary changes? Do they possess the necessary skills, knowledge, or awareness to want to adapt and be able to do so? What other stressors are they subject to? How are their potential adaptation choices affected by the social, economic, political, and governmental circumstances under which they live (van Aalst et al., 2008)?

What naturally follows from such participatory approaches is incorporating climate change adaptation into livelihood strategies. Once community vulnerability is situated within a wider social, economic, political, and governmental context, and capacity for adaptation is assessed, communities can begin planning adaptation. It is at this point that exogenous adaptation can play a critical role in helping communities institute social structures and processes that foster access to resources. Through integration of exogenous and endogenous strategies, adaptation efforts can address persistent vulnerabilities and immediate constraints on adaptive capacity within small communities, creating the opportunity for coordinated efforts to address climate stressors on larger spatial and temporal scales.

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